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# Development of an integrated test instrument for Islamic value to measure mathematical reasoning of students in the Islamic mathematics study courses

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## Abstract

The project aims to establish an integrated Islamic values exam instrument for assessing students' mathematical thinking. The research methodology employed in this study is the 4-D development model (Four D model) devised by Thiagarajan. This model encompasses four stages: a) defining, b) designing, c) developing, and d) distributing. In order to assess the soundness, consistency, and level of challenge of the test tool in this research, we employed SPSS 20 software to analyze the data. The results obtained after doing an analysis using SPSS 20 to assess validity, reliability, and test difficulty are as follows: The test instrument consists of 5 legitimate questions and 5 moderately difficult questions. However, the combined Islamic values in the test instrument are not dependable, as indicated by a reliability coefficient of 0.510.

**Keywords:** Instrument; Islamic Value; Mathematical Reasoning; Islamic Mathematics; Mathematics Study

## 1. Introduction

Mathematics is a science of great relevance as it influences human mind about concepts, processes, and reasoning. Through the process of logical thinking, individuals are able to differentiate between concepts that are considered positive or negative, advantageous or disadvantageous. Undoubtedly, it is possible to effectively tackle current issues by employing logical thinking. Reasoning plays a significant role in the formation of one's character within the realm of schooling. Reasoning encompasses the capacity to engage in logical reasoning, evaluate circumstances, and reach conclusions using reasonable thought processes. Consequently, through a gradual process, the formation of character starts to materialize [1] The process of developing the characters starts to form, with an educator playing a crucial part. In order to successfully facilitate the learning process, an educator must possess the ability to create meticulously organized learning experiences using appropriate methods or approaches that are in line with the students' specific situations. Creating efficient evaluation tools is a crucial aspect of the educational process, particularly when it comes to gauging students' mathematical reasoning skills [1]. The Islamic Mathematics Studies course is essential for combining mathematical comprehension with Islamic principles, emphasizing not just cognitive components but also emotive and spiritual dimensions.There is a pressing demand in higher education, especially in programs that integrate mathematics and Islamic principles, to create assessment tools that not only gauge academic aptitude but also evaluate the degree to which students can internalize and apply Islamic values in their comprehension and logical thinking in mathematics [2].

Mathematical reasoning is a fundamental skill that is essential for mathematics students to have [1]. This cognitive process entails the capacity to engage in logical thinking, establish relationships between ideas, and approach problem-solving in a methodical manner. Mathematical thinking, viewed through an Islamic lens, acknowledges that mathematics serves as a means to grasp the magnificence and systematic nature of Allah's creation [3]. Hence, including Islamic principles into the design of evaluation tools might offer a more significant framework for students and enhance their

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moral and spiritual growth. Prior studies suggest that incorporating religious beliefs into teaching might improve students' motivation and conceptual understanding. Nevertheless, there is a scarcity of research focused on the creation of test instruments that expressly incorporate Islamic principles into the realm of mathematical thinking. The majority of modern test tools largely emphasize cognitive features while neglecting the emotive and spiritual factors. Hence, it is crucial to establish comprehensive measures for assessing Islamic values [4]. The created tools should be capable of measuring students' mathematical reasoning abilities as well as evaluating their ability to incorporate Islamic principles into their thinking processes. Our aim is to cultivate a generation that is not only intellectually astute but also has a robust character rooted in Islamic principles.

The development of this exam instrument is anticipated to serve as a paradigm for other educational institutions seeking to include religious beliefs into mathematical teaching. Moreover, researchers may employ this tool to investigate the influence of integrating Islamic principles on improving logical thinking abilities and shaping students' moral development. Therefore, this study not only enhances the progress of knowledge, but also We cannot translate the statement since it already exists in Indonesia.

## 2. Research methodology

The development model of test instruments in this study uses the 4-D model (Four D model) developed by S Thiagarajan, Dorothy S Semmel, and Melvyn I Semel in 1947: a) definition, b) design, c) development [5]. Islamic mathematics experts, together with students enrolled in the Islamic Mathematics Studies course of the Mathematics Education Study Program for the 2022 cohort, act as expert validators in research and development. The data collection for this research and development project involved the utilization of the following instruments: Expert validation tools are utilized to assess the validity and appropriateness of the generated product. In this work, an Islamic mathematics expert was provided with an expert validation instrument to ensure a seamless integration of mathematical material with Islamic principles. The tool encompasses the following elements: appropriateness of material, linguistic proficiency, delivery, visual aesthetics, incorporation of Islamic mathematics, and assessment. The validity of the instrument may be evaluated in two ways: overall instrument validity and item validity. Aiken's validity coefficient assesses the validity of the numeracy and reading interest test. Aiken devised the Aiken's V formula for determining the content validity coefficient. The evaluations are derived from a panel of n experts who evaluate the extent to which an item accurately reflects the conceptual construct being assessed. Aiken presents the formula as outlined in reference [6]

$$V = \sum s / [n(C-1)]$$

Explanation

''s = r - lo
lo = the lowest rating (for example, 1)
C = the highest rating (for example, 4)
r = the score given by the evaluator

Aiken's formula technique will condense the calculation findings and analysis into a validity category or classification. The classification of content validity is consistent with Guilford's suggested validity category [1]. The parameters outlined by Guilford (1956) are as follows: 080 < $r_{xy}$ < 100: exhibits a very high level of validity (excellent); 060 < $r_{xy}$ < 080: demonstrates a high level of validity (good); 040 < $r_{xy}$ < 060: indicates a moderate level of validity (sufficient); 020 < $r_{xy}$ < 040: suggests a low level of validity (poor); 000 < $r_{xy}$ < 020: signifies a very low level of validity (terrible); and finally, $r_{xy}$ < 000: does not possess any validity.

## 3. Results and discussion

The study's instrument product is a mathematics exam that combines Islamic concepts. The researcher got the data analysis and findings of this study at each stage of the construction of the 4-D (Four-D) model.

### 3.1. Define Stage

At this level, the first step is to analyze the criteria for creating mathematical problems that integrate Islamic concepts. The subsequent phase is scrutinizing the submitted content. During this phase, we determine the extent of the content and the skills that necessitate mathematical reasoning. Subsequently, we adapt the questions to correspond with these skills.

### 3.2. Design Stage

During the design phase, the researcher develops a test instrument that integrates Islamic principles with mathematical problems. This device comprises a grid of instruments, mathematical problems, and answer keys.

**Table 1** Integrated Mathematics Test Question Instruments with Islamic Values

| Subject matter | Mathematical reasoning indicator | Question number |
|---|---|---|
| Combinatorics | be able to identify the number of verses in Surah As-Shams, At-Tin, Al-Qariah, and Al-Insyirah and understand that these represent the number of green and blue balls in each box. | 1 |
| | Count the total number of green balls in both boxes (15 green balls in the first box and 11 green balls in the second box) | |
| | Using the principle of combinatorics to calculate the number of ways to choose green balls from two boxes: 15+11. | |
| | systematically compile the steps from information identification to final summation | |
| | Please recheck the calculation and ensure that the result, which is 26 ways, is correct | |
| Arithmetic | Realizing that the time needed for one round of tawaf is the same as the time for one sa'i journey, and using it to form an equation | 2 |
| | Solving the equation $14t$=84 for $t$ | |
| | Converting time from minutes to seconds to obtain the final result in the requested unit | |
| | Ensuring that the calculation results are consistent with the provided information and reasonable within the given context | |
| Algebra | Identifying the information provided in the problem, including the mathematical expressions that need to be simplified and the given values such as r=5 | 3 |
| | Using algebraic identities, to reduce or simplify complex mathematical expressions into a simpler form | |
| | Selecting and implementing the appropriate strategy to find one of the factors of the given mathematical expression In this case, the strategy used is to try several values of m and n to find the value that satisfies the given expression | |
| | Understanding the context of the question (for example, the meaning of the takbir in the second rak'ah of Eid al-Adha prayer) and applying algebraic concepts accurately to answer the question | |
| Number Theory | Understanding the basic concepts of number theory, such as integer division and number factorization | 4 |
| | Using knowledge of number factorization to find all factors of 2022+$m$ | |
| | Using logical reasoning to find all values of n that satisfy the given mathematical conditions | |
| | Understanding the context of the question, which is that m represents the number of verses in Surah Al-Bayyinah, and then applying their mathematical knowledge to solve this problem effectively | |
| Geometry | Identifying the mathematical relationship between the radius, circumference, and area of a circle based on the information provided in the problem | 5 |
| | Using circle geometry formulas, such as the circumference formula | |
| | Developing effective problem-solving strategies to find the value of p and the difference in the areas of circles. | |

| | | |
|---|---|---|
| | To verify the correctness of their solution, students must be able to recheck all calculation steps by finding the value of 'p' and the difference in areas | |
| | Understanding the context of the question, for example that 'p' is given as the sequential number of Surah An-Nisa' in the Quran, and applying their mathematical knowledge within the given context | |
| Exponent Function | Understanding the concept of functional equations | 6 |
| | Implementing functional equations | |
| | Understand the context of the problem, such as the meaning of d as "many days of tasyrik" and its relationship to the values of the function f(x). | |

### 3.3. Development Stage (Develop)

During the development stage, the researcher carries out expert validation activities and tests the development of the instrument.

### 3.4. Expert Validation

In order to validate our study, we distributed integrated mathematics exam instruments with Islamic values to three validators: two mathematics academics from UIN and one mathematics teacher, MTs. Alkhairaat Biromaru. The following table presents the outcomes of expert validation using Aiken's V formula.

**Table 2** Results of the Calculation of the V Aiken Index for Integrated Mathematical Reasoning Questions with Islamic Values

| **''Question item''** | **assessment (r)** | | | **s1** | **s2** | **s3** | **Σs** | **V** | **information** |
|---|---|---|---|---|---|---|---|---|---|
| | **Validator 1** | **Validator 2** | **Validator 3** | | | | | | |
| 1 | 4 | 3 | 3 | 3 | 2 | 2 | 7 | 0,77 | high value |
| 2 | 3 | 3 | 3 | 2 | 2 | 3 | 6 | 0,66 | high value |
| 3 | 4 | 3 | 3 | 3 | 2 | 2 | 7 | 0,77 | high value |
| 4 | 4 | 3 | 3 | 3 | 2 | 2 | 7 | 0,77 | high value |
| 5 | 3 | 3 | 3 | 2 | 2 | 2 | 6 | 0,66 | high value |
| 6 | 3 | 3 | 3 | 2 | 2 | 2 | 6 | 0,66 | high value |

The foregoing research demonstrated that all exam items in integrated mathematical reasoning with Islamic principles possess a high level of validity. Nevertheless, the input from the validators indicates that several questions need to be enhanced since they do not align with the appropriate cognitive level and language. Consequently, the researcher included the advice provided by all three validators about typing, the use of formal language, and the cognitive level into the revised version.

### 3.5. Empirical Analysis

#### *3.5.1. Validity Test*

Validity comes from the word validity, which means the extent to which a measuring instrument (test) accurately and precisely performs its measuring function A test is said to have high validity if the instrument carries out its measuring function accurately or provides measurement results consistent with the intended purpose of the measurement [7]. The following table presents the outcomes of the item validity calculation conducted using SPSS 20.

**Table 3** Validity Results of Integrated Islamic Value Items

| Validity index | Items | total | presentation |
|---|---|---|---|
| > 0,361 ( Valid) | 1,2,3,5,6 | 5 | 90% |
| < 0,361 (Invalid) | 4 | 1 | 10 % |

The assessment of the integrated mathematical reasoning test with Islamic principles reveals that certain problems require further examination.

*3.5.2. Reliability*

The reliability test is employed to evaluate the amount of consistency in an instrument. An effective instrument will yield consistent measurement outcomes and maintain consistent responses over several instances. The reliability analysis findings are analyzed using SPSS 20, as shown in the table below.

**Table 4** Results of the Reliability Analysis of Integrated Islamic Value Questions

| Cronbach's Alpha | N of Items |
|---|---|
| .510 | 6 |

According to Fraenkel, Wallen & Hyun (2012), an instrument is considered reliable if its reliability factor is greater than 0,70 [8]. However, based on the table above, it appears that the instrument is not reliable, as it has a reliability coefficient of 0,510 Therefore, it can be concluded that the instrument is unreliable because its reliability coefficient is less than 0,70.

*3.5.3. The difficulty level*

The difficulty level is employed to ascertain the level of complexity of the test instrument. The following table presents the outcomes of the difficulty level assessment.

**Table 5** Results of the Difficulty Level Test

| "Question number" | Difficulty ahead | "Categories of questions" |
|---|---|---|
| 1 | 0,697 | Medium Category |
| 2 | 0,413 | Medium Category |
| 3 | 0,475 | Medium Category |
| 4 | 0,446 | Medium Category |
| 5 | 0,43 | Medium Category |
| 6 | 0,21 | Difficult Category |

Upon analyzing the table provided, it is evident that the integrated test instrument consists of 5 questions categorized as moderate difficulty and 1 question categorized as difficult.

*3.5.4. The Dissemination Stage*

In this phase, the product will be distributed to two institutions in Palu, namely the Faculty of Education and Teacher Training (FKIP) Mathematics Program at Alkhairaat University and the Mathematics Education Program at UIN Datokarama

## 4. Conclusion

The research findings indicate that the creation of an integrated Islamic values evaluation instrument utilizing the 4-D development model involves four distinct stages: The process consists of four phases: (1) the definition phase, which

encompasses the initial and final analysis, student input, and concepts; (2) the design phase, which entails creating the instrument grid and formulating questions; (3) the development phase, which involves expert validation and development testing; and (4) the dissemination stage, which includes distributing the final product to two universities in Palu. The results obtained after doing an analysis using SPSS 20 to assess validity, reliability, and test difficulty are as follows: The test instrument consisted of five legitimate questions and five moderately tough questions. The reliability coefficient of 0.510 suggests that the integrated Islamic values in the test instrument are not reliable.

## Compliance with ethical standards

*Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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